Changes in Wound Field Lipids in Rat Skin

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Intricate dynamics of lipid transformations was detected in rat skin wound field during regeneration. The content of lipids increased in the granulation fibrous tissue during the early period of regeneration and decreased later. On day 23 the regeneration process was over, the formed scar tissue differed from intact skin by the content of many lipid fractions. In the crust and skin sites adjacent to the wound the regeneration was associated with significant changes in the lipid composition.

Key Words: *skin; wound process; regeneration; lipids*

Regeneration of skin wounds is an intricate multistage process associated with a variety of changes in the wound field components: granulation fibrous (GF) and scar tissues, crust, and skin sites adjacent to the wound. Morphological studies of GF and scar tissues, crust, and adjacent skin [2,3,6,9] revealed biochemical characteristics of GF tissue at different stages of regeneration (days 5, 7, 8, 14, and 21) [1,5,7]. On the other hand, complex study of tissues forming at the site of injury was never given due attention. Lipids play an important role in the regeneration process. We studied the dynamics of lipids in the wound field tissues in rats.

MATERIALS AND METHODS

Experiments were carried out on male Wistar rats. The skin of intact animals and tissues from the skin wound field were analyzed: GF, scar, crust, and adjacent skin sites. GF tissue was obtained by the method of Slutskii. The animals were narcotized with ether, the skin the interscapular area was cut, and a polymethyl methacrylate ring was mounted in this incision [4]. Wound surface was covered with a crust, under which GF tissue developed. The ring was removed 5 and 8 days after surgery and specimens of GF tissue, crust, and adjacent skin were collected. In order to collect scar tissue specimens, the ring was removed on day 8 and the wound healed until day 23. Total lipids (TL) were extracted after Folch. Lipid fractions were separated by microthin-layer chromatography on silica gel [4]. The results were statistically processed using standard algorithms.

RESULTS

Regeneration of skin wounds is associated with significant changes in the lipid composition of skin wound field (Table 1). An increase in TL content in GF tissue of rats was observed during the early period of regeneration (day 5), specifically, in triglyceride content (~72% TL). Microscopy of the sections showed numerous large lipid droplets scattered in the entire thickness of GF tissue. It seems that the biological essence of lipid accumulation consists in creation of a depot of material which can serve as the source of energy for cell growth and division, and for synthesis of cellular matrix [9]. Later an almost 2-fold drop of TL level was observed (day 8), mainly at the expense of free fatty acids (FFA) and triglycerides. This fact seemed to be due to decreased delivery of various substances, *e.g.* lipids, to the wound area because of significant

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TABLE 1. Lipid Content in Rat Skin Wound Field during Regeneration (mg/100 g wet tissue; $M\pm m$; n=6)

Tissue	Day of regeneration	TL	Phospholipids	Diglycerides	Cholesterol	FFA	Triglycerides	Cholesterol esters
Intact skin		1726±121	254±17	38±3	110±8	197±14	774±54	353±28
GF tissue	5	4013±281	238±18	189±12	183±12	298±21	2903±203	202±16
	8	2120±169^{+}	230±18	111±8^{+}	159±13	178±13^{+}	1321±93^{+}	121±10^{+}
Scar tissue	23	2329±186*	249±17	157±11*$^{+}$	153±12*	373±30*$^{+}$	1117±89*	280±22^{+}
Crust	5	1537±107	359±25	118±8	159±13	472±33	216±15	213±17
	8	1230±86	360±25	212±15^{+}	107±6^{+}	275±22^{+}	151±11^{+}	125±10^{+}
Adjacent skin	5	1932±135	282±20	45±3	130±9	227±18	851±59	397±20
	8	1831±146	166±13*$^{+}$	130±9*$^{+}$	108±8	244±17	1022±71*	161±13*$^{+}$

Note. $p<0.05$ compared to: *intact tissue, $^{+}$previous term.

restructuring of metabolism in maturing GF tissue [2,3,9]. The content of TL in the scar tissue (day 23 of the experiment) virtually did not change in comparison with the previous term, while the content of FFA, diglycerides, cholesterol esters increased, which seemed to indicate the requirements of new scar tissue in metabolic energy, provided by lipids. The scar tissue differs from intact skin by many morphological and biochemical parameters [2,3]. Very high levels of TL and FFA, triglycerides, and cholesterol can be due to their utilization for repair of lost skin derivatives (glands and hair).

The content of TL in the crust is low and tends to decrease during regeneration (Table 1). The main characteristic of the fraction composition of the crust is low percentage of triglycerides (12-14% of TL), their content decreasing during healing, as well as the content of the majority of lipid fractions. Presumably, the decrease in lipid content in the crust reflects necrosis and fibrous transformation processes in it [9].

The skin adjacent to the wound directly participates in the healing of full-layer skin wounds [8]. However, there were no deep changes in the lipid composition of the adjacent skin during the early period of regeneration (Table 1). The most significant changes in lipids were observed only on day 8 of the study, when the level of cholesterol esters decreased and diglyceride and triglyceride levels increased. Presumably, the hydrolytic degradation of phospholipids with participation of phospholipase C and formation of diglycerides and then triglycerides is activated during this period.

Our findings suggest a relationship between lipid components of the rat skin wound field: GF and scar tissues, crust, and skin adjacent to the wound and their direct participation in the healing of full-layer skin wounds.

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